Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

SHOUT
SHARE
IT

Reserve

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 1069

Washington, D. C.

Issued May 19, 1922
Revised March 29, 1924

RELATION OF PRODUCTION TO INCOME FROM DAIRY COWS.

By J. C. McDowell, *Dairy Husbandman, Dairy Division, Bureau of Animal Industry.*

CONTENTS.

	Page.		Page.
Purpose of the work	1	Relation of butterfat production to income	5
Character of data used	2	Prices and profits	14
How the records were studied	3	Relation of milk production to income	14
General averages of production, feed cost, and income	4	What the cow-testing association can and can not do	19
Quality of cow-testing-association cows	5	Summary and conclusions	20

PURPOSE OF THE WORK.

Large yields of milk and butterfat per cow are the aim of most dairymen and also of most breeders of dairy cattle. It is plain that the income from a farm dairy depends ultimately on the earning capacity of the individual units in the herd—the cows. The purpose of the work here reported is to analyze a large number of records and to show the relation between the productivity of cows and the income received by their owners. The records used are those of cow-testing associations.

Such an association, as ordinarily conducted in this country, is an organization of about 26 dairy farmers who cooperatively employ a man to test their cows for production of milk and butterfat. As the tester can ordinarily test only one herd a day, the 26 dairy herds furnish employment for each working day in the month. Records from a large number of cow-testing associations are a veritable mine of useful information. They cover a wide range of interesting dairy topics and show actual production under normal farm conditions.

For the purpose of this bulletin the records of individual cows from 96 cow-testing associations have been tabulated to show the relation of production to cost of feed and to income over cost of feed and

to ascertain the best methods of dairy-herd management. Some of the 96 associations furnished records for more than one year. In such cases the records for each year were tabulated as though they were from different associations. On that basis the 96 associations furnished 120 sets of records. Therefore, to determine from these figures the average number of cows on test in an association we must consider each set of records as a separate association.

In the 120 sets of records there were 2,939 herds and 41,990 cows on test. The study covered the period 1910 to 1920, inclusive; but every cow record was for a period of one year, the records of less than one year being included only when making herd and association summaries. In all other tabulations 12 months' records only were used.

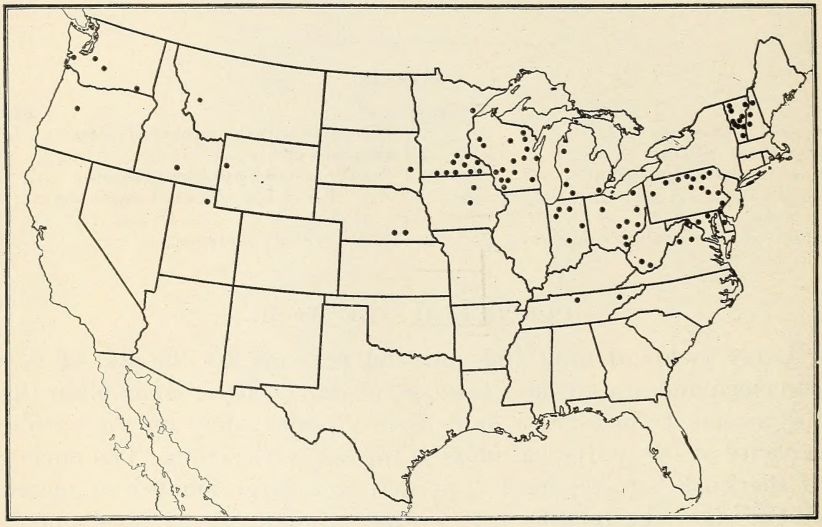

FIG. 1.—Location of the 96 cow-testing associations whose records were tabulated.

It is well known that cows having high-production records are generally more profitable than those whose production records are not so high, and this bulletin shows the rate at which income over feed cost advances as average production increases.

CHARACTER OF DATA USED.

Figure 1 shows the distribution of the cow-testing associations whose records were tabulated.

So far as practicable the records of each association were studied independently of the others before being grouped into general tables. In this way any differences due to geographical location were noted and interpreted.

The first cow-testing association in the United States began work in Newaygo County, Mich., in 1906. On July 1, 1921, there were

452 active associations in the United States. The map (fig. 2) shows the location of these associations.

HOW THE RECORDS WERE STUDIED.

The individual cow record includes the name, breed, age, and weight of the cow. It also includes date of freshening, names of dam and sire, months in milk, pounds of milk produced, butterfat test, pounds of butterfat, price of product, total value of product, feed consumed, days on pasture, cost of pasture, cost of roughage, cost of grain, income over cost of feed, returns for $1 expended for feed, feed cost per pound of butterfat, and feed cost per 100 pounds of milk.

In making the herd and association summaries here discussed the records of all cows on test 4 months or more were included. That is

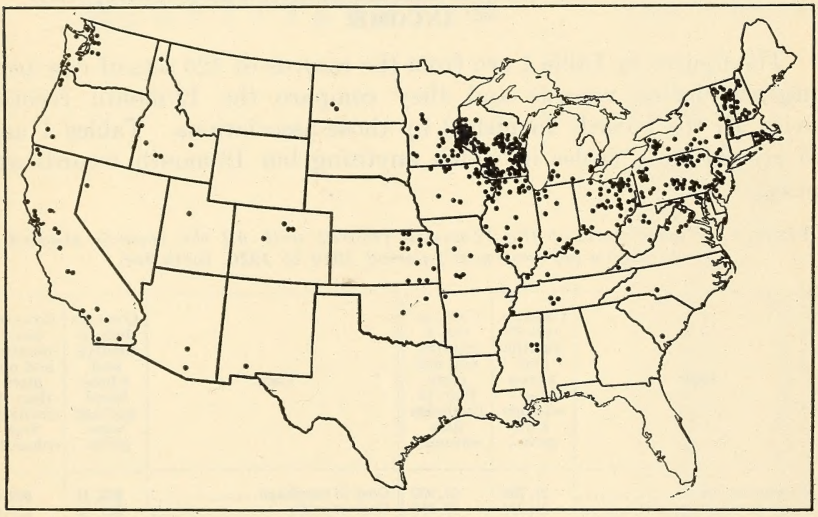

FIG. 2.—Location of the 452 cow-testing associations in the United States, July 1, 1921.

the way such summaries are made by the testers in nearly all the cow-testing associations in the United States. In all other tabulations only the records of cows that were on test 12 consecutive months and had breed and age given were used. The reason for discarding the shorter records in making tabulations was to avoid possible error due to the use of such records. The possible error due to a use of such records, however, is probably negligible, as average yield, cost, and income proved to be about the same per cow-year [1] when the records of all cows on test were included as when only the records of those on test 12 months were included. (See Table 1.) This indicates that the herd and association summaries as now ob-

[1] See footnote to Table 1.

tained show about the same averages as they would if 12-months records only were used. The cows discarded before the end of the testing year were inferior cows, which would tend to lower average production, but they generally were on test during the early part of their lactation period, which would tend to increase average production. The figures shown in Table 1 indicate that these two influences nearly offset each other when large numbers of records are used.

This bulletin considers feeds chiefly from the standpoint of the income they produce over their cost but a study is now being made of the cow-testing-association records to determine the relation of feeds to other factors, in which feeds of various kinds are considered by quantity and feeding value.

GENERAL AVERAGES OF PRODUCTION, FEED COST, AND INCOME.

The figures in Table 1 are from the records of 120 sets of cow-testing-association records and they compare the 12-month records with all the records furnished by those associations. Tables 1 and 5 are the only tables in which anything but 12-month records are used.

TABLE 1.—*Comparison of the 12-month records with all the records studied—Averages per cow-year; period 1910 to 1920, inclusive.*

Item.	Cows on test 12 months and whose breed and age were given.	Cows on test 4 months and not more than 12 (includes first column).	Item.	Cows on test 12 months and whose breed and age were given.	Cows on test 4 months and not more than 12 (includes first column).
Number of cows	21,234	41,990	Cost of roughage	$33.41	$32.03
Number of cow-years [1]	21,234	37,362	Cost of grain	$21.89	$21.03
Average milk yield, pounds	6,077	5,989	Total feed cost	$55.30	$53.06
Butterfat test, per cent	4.08	4.12	Income over feed cost	$62.70	$59.33
Average butterfat, pounds	248	247	Returns for $1 expended for feed	$2.13	$2.11
Price of butterfat	$0.48	$0.46			
Value of product	$118.00	$112.39			

[1] A cow-year may be the record of 1 cow on test 12 months, or it may be made up of the records of 2 or more cows the sum of whose testing periods equals 12 months.

The average milk production per cow-year for the cows on test 12 months was 6,077 pounds, while the average milk production for all the cows on test was 5,989 pounds, a difference of only 88 pounds. The average production of butterfat per cow-year was 248 pounds for the cows on test 12 months and 247 pounds for all the cows on test, a difference of only 1 pound. In return for $1 expended for feed there was a difference of only 2 cents per cow-year. For the cows on test 12 months the returns averaged $2.13 and for all the cows on test the returns averaged $2.11.

QUALITY OF COW-TESTING-ASSOCIATION COWS.

The estimated production per cow of all the dairy cows in the United States is approximately 4,000 pounds of milk and 160 pounds of butterfat a year. The records of association cows show them to be approximately 50 per cent above average in both milk and butterfat production, because the average production of those whose yearly records have been tabulated was 6,077 pounds of milk and 248 pounds of butterfat.

The greater yield of cows owned by association members is due to various causes, but is due chiefly to better feeding, breeding, and care.

RELATION OF BUTTERFAT PRODUCTION TO INCOME.

For Table 2 the records were sorted and grouped according to production of butterfat, each successive group center being 50 pounds above the one before it.

TABLE 2.—*Relation of butterfat production to income over cost of feed when the product was sold as butterfat; years 1910 to 1920, inclusive.*

Group No.	Number of cows.	Butterfat range.	Production average.	Average price of butterfat.	Average income over cost of feed.
		Pounds.	*Pounds.*		
1	4	0–25	23	$0.38	[1] $31.35
2	43	26–75	58	.41	[1] 13.88
3	600	76–125	109	.44	12.48
4	2,305	126–175	154	.44	27.90
5	4,310	176–225	202	.44	42.45
6	4,748	226–275	251	.44	57.82
7	3,385	276–325	298	.44	73.34
8	1,635	326–375	347	.44	89.67
9	652	376–425	395	.44	105.07
10	214	426–475	446	.45	124.85
11	79	476–525	493	.43	135.30
12	27	526–575	543	.40	134.80
13	8	576–625	600	.41	157.87
14	3	626–675	642	.43	150.62
15	1	676–725	708	.29	108.18
Total	18,014				
Average			248	.44	57.44

[1] Loss.

The income from these 18,014 cows was obtained from the sale of butterfat. As the price received per pound varied little in the larger groups, the variation in income over cost of feed for those groups could not have been due to a difference in price of product. Evidently it was due to a difference in average production per cow, and this difference in production was due partly to the cows and partly to the way the cows were fed and cared for.

The group whose average yearly butterfat production was 154 pounds, or a little below that of the average dairy cow, had an average income of $27.90 over cost of feed, while the group whose average

yearly butterfat production was 251 pounds, or about that of the average association cow, had an average income of $57.82 over cost of feed, or more than twice as much. Income over cost of feed per cow is what remains for labor, miscellaneous expenses, and profits.

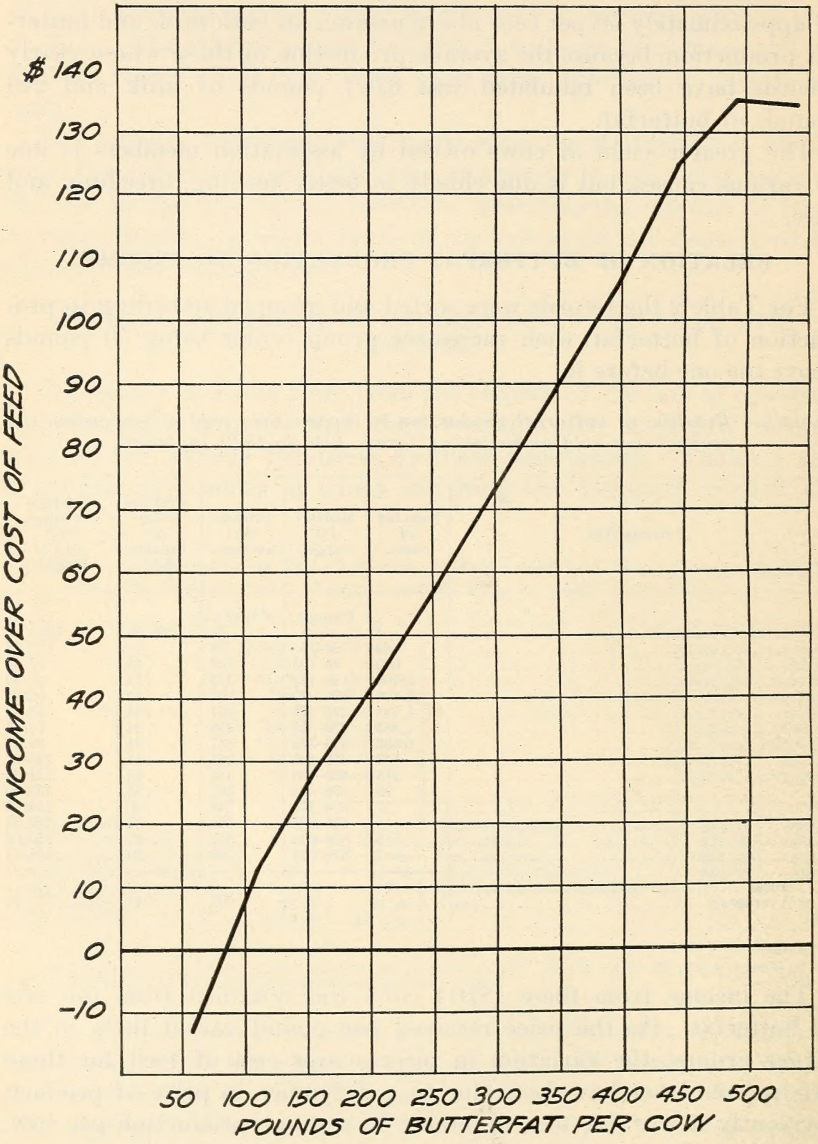

FIG. 3.—Relation between butterfat production and income over cost of feed.

Figure 3 shows in graphic form the relation of butterfat production to income over cost of feed as recorded for the larger groups in Table 2.

From this curve the income over cost of feed for each 50 pounds of gain in butterfat production may be determined. It is well known that dairy cows, to be profitable, must be comparatively large producers, yet few people fully realize the remarkable rate at which income over cost of feed advances as production increases. The chart shows that as average butterfat production increased from 150 to 200 pounds, the average income over cost of feed advanced from $26 to $42; that is, a gain of 50 pounds in butterfat production increased the income over cost of feed $16, or nearly 62 per cent. The next gain of 50 pounds raised the income over cost of feed to $58, the next to $74, the next to $90, and the next to $106.

Briefly stated, as production of butterfat increased from 150 to 400 pounds, the income over cost of feed advanced from $26 to $106,

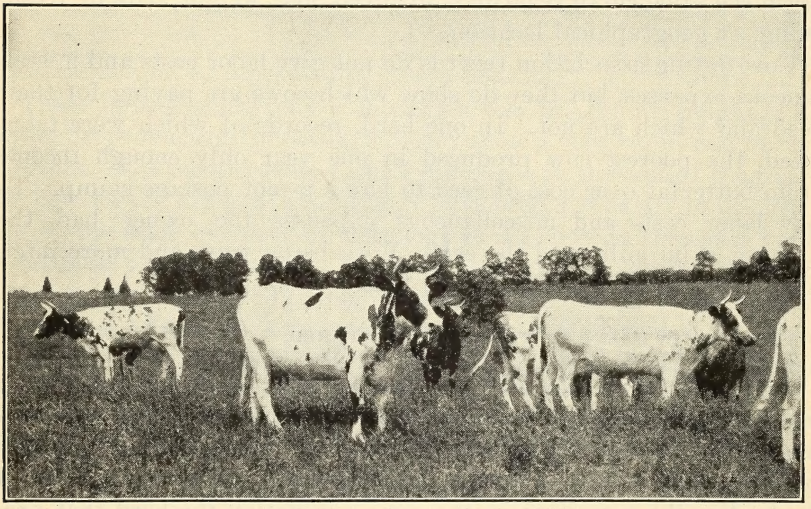

FIG. 4.—An Ayrshire herd in the Herndon (Va.) cow-testing association.

or exactly $16 for each gain of 50 pounds in butterfat production. As butterfat production increased from 400 to 450 pounds the gain in income over cost of feed was about $19. For the groups whose average production was above 450 pounds the income above feed cost was somewhat irregular, which may have been due to the fact that the number of records was too small to give dependable averages, or there may have been a point beyond which the cows did not respond so readily to more liberal feeding. Undoubtedly there is a point beyond which it does not pay to feed for increased production, but evidently that point is seldom passed in the feeding of cow-testing-association cows.

As prices of feeds and prices of dairy products rise and fall the income over cost of feed also may rise and fall, but a study of the

figures by districts and by years in the relation of production to income over cost of feed shows that any change for one group of cows was always accompanied by a similar change for each of the other groups. For that reason the curve shown in figure 3 may be considered as fairly representative for different years and for all sections of the country. It does not follow, however, that the income over cost of feed will always be $26 for cows that produce 150 pounds of butterfat and $106 for cows that produce 400 pounds of butterfat. The figures are relative, not absolute. The records were tabulated in many ways and always with the result that the groups of high-producing cows had a greatly increased average income over cost of feed as compared with the groups of low-producing cows. The figures showing the relation of butterfat to income gave much the same curve regardless of breed, age, weight, date of freshening, or geographical location.

Cow-testing-association records do not give labor costs and miscellaneous expenses, but they do show which cows are paying for their feed and which are not. In one herd, records of which were tabulated, the poorest cow produced in one year only enough income from butterfat over cost of feed to buy a 2-cent postage stamp. To pay labor costs and miscellaneous expenses the owner had the manure, skim milk, and the calf. With better cows and more intelligent feeding he would have had much more.

TWO HERDS COMPARED.

In the Cheshire (N. H.) cow-testing association for the testing year 1917-18 the herd that produced the most milk per cow was highest in average production of butterfat, highest in cost of feed per cow, and averaged next to the highest in income over cost of feed. For the same year in the same association the herd that produced the least milk per cow was lowest in average production of butterfat, lowest in average gross income, lacked 4 cents of being lowest in cost of feed per cow, and averaged lowest in income over cost of feed. The herd of greatest production per cow had an average income of $212 over cost of feed, while the other herd had an average income of $27 over cost of feed. It would require 78 cows like those in the inferior herd to produce as much income over cost of feed as 10 cows like those in the other.

BUTTERFAT AND COST OF FEED.

The figures in Table 3 are from the same tabulation as those given in Table 2, and they show the relation between butterfat production and cost of feed per cow.

TABLE 3.—*Relation of butterfat production to cost of feed when the product was sold as butterfat.*

Group No.	Number of cows.	Average butterfat production.	Average cost of feed.		
			Roughage.	Grain.	Total.
		Pounds.			
1	4	23	$29.36	$10.62	$39.98
2	43	58	30.85	7.12	37.97
3	600	109	28.08	7.62	35.70
4	2,305	154	29.61	10.94	40.55
5	4,310	202	31.54	15.73	47.27
6	4,748	251	33.44	20.34	53.78
7	3,385	298	34.26	25.02	59.28
8	1,635	347	35.27	28.91	64.18
9	652	396	34.70	34.65	69.35
10	214	446	37.27	38.88	76.15
11	79	493	39.12	38.52	77.64
12	27	543	36.30	45.69	81.99
13	8	600	40.23	50.55	90.78
14	3	642	41.41	82.72	124.13
15	1	708	45.08	51.87	96.95
Total	18,014				
Average		248	32.75	20.12	52.87

These figures show only a moderate rise in cost of roughage as butterfat production increases, but they show a very rapid rise in cost of grain. The comparatively small difference in the cost of roughage per cow for the different groups may have been due partly to the feeding of the same quantity of roughage to all cows in the same herd, regardless of production. The increased cost of grain, however, was very regular as production increased. This was always true when the number of records in the group was great enough to furnish a fair average. Evidently many of the members of cow-testing associations

TABLE 4.—*Relation of butterfat production to returns for $1 expended for feed and to feed cost per pound of butterfat where the product was sold as butterfat.*

Group No.	Number of cows.	Average butterfat production.	Average returns for $1 expended for feed.	Average feed cost per pound of butterfat
		Pounds.		
1	4	23	$0.22	$1.758
2	43	58	.63	.648
3	600	109	1.35	.323
4	2,305	154	1.69	.264
5	4,310	202	1.90	.238
6	4,748	251	2.08	.214
7	3,385	298	2.24	.199
8	1,635	347	2.40	.185
9	652	396	2.52	.175
10	214	446	2.64	.171
11	79	493	2.74	.157
12	27	543	2.64	.151
13	8	600	2.74	.151
14	3	642	2.21	.193
15	1	708	2.12	.137
Total	18,014			
Average		248	2.09	.213

are feeding concentrates intelligently, according to known production. That, however, is not at all a general practice outside of the cow-testing associations.

RETURNS FOR $1 EXPENDED FOR FEED.

The figures in Table 4, also taken from the same tabulation as those in Table 2, show the relation of butterfat production to returns for $1 expended for feed, and to feed cost per pound of butterfat.

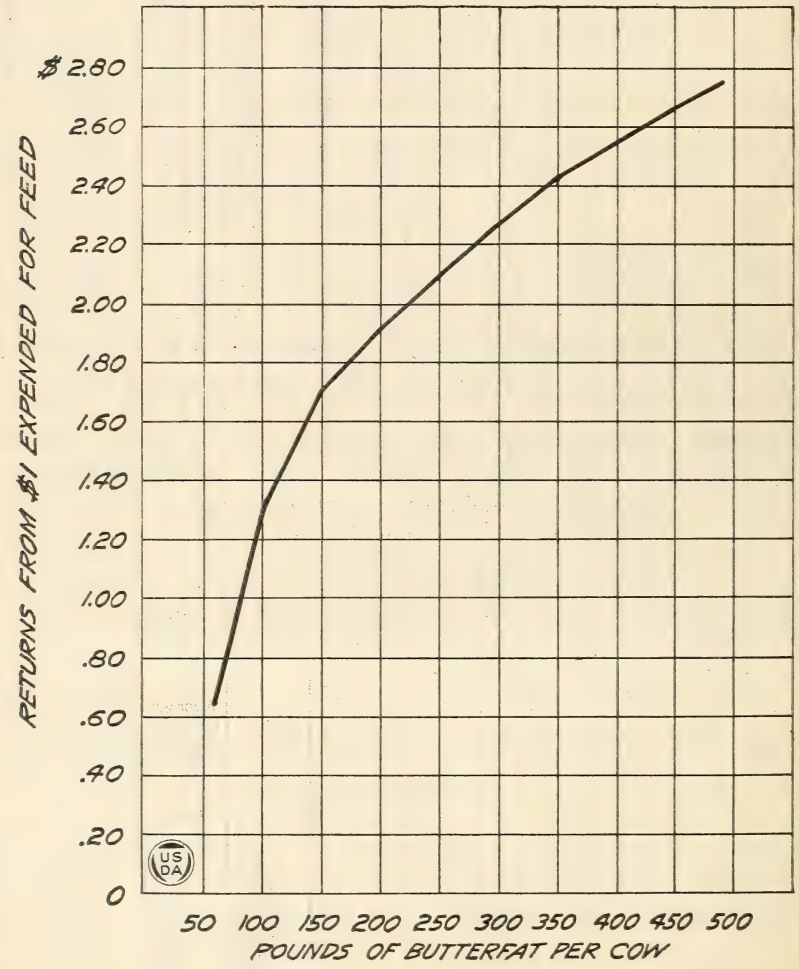

FIG. 5.—Relation between butterfat production per cow and the returns from $1 expended for feed.

The returns for $1 expended for feed increased quite regularly, and the feed cost per pound of butterfat decreased quite regularly

for each successive large group. As production increased from 109 pounds in the third group to 396 pounds in the ninth group, the returns for $1 expended for feed increased from $1.35 to $2.52, or almost doubled. In Group 3 the returns were only 35 cents above the cost of the feed, while in Group 9 the returns were $1.52 above the cost of the feed, or more than four times as much. It is also worthy of note that the feed cost per pound of butterfat was almost twice as high in Group 3 as in Group 9.

Figure 5 shows graphically for the larger groups the relation of butterfat production to returns for $1 expended for feed as given in Table 4.

FIG. 6.—One of the highest-producing herds in the Carroll County (Md.) cow-testing association.

The curve shows that the returns for $1 expended for feed increased at a very rapid rate as production of butterfat increased. The larger returns for feed in the groups having high average production were due to better cows and better feeding. The relative influence of these two factors can not be determined because the groups whose average production was high were always fed more liberally than those whose average production was lower.

Figure 7 shows graphically for the larger groups the relation between butterfat production and feed cost per pound of butterfat as given in Table 4.

The curve shows a very rapid decrease in feed cost per pound of butterfat as production increased from 58 pounds to 396 pounds. From that point on the feed cost per pound of butterfat decreased more slowly. The figures indicate that from the standpoint of feed cost alone the dairyman should give close attention to the improve-

ment of low producers or eliminate them. The figures from which curves were made cover the period 1910 to 1920, inclusive. When prices were high the curves had a slightly different position from what they had when prices were low, but always the curves followed the same general direction regardless of cost of feed or price of

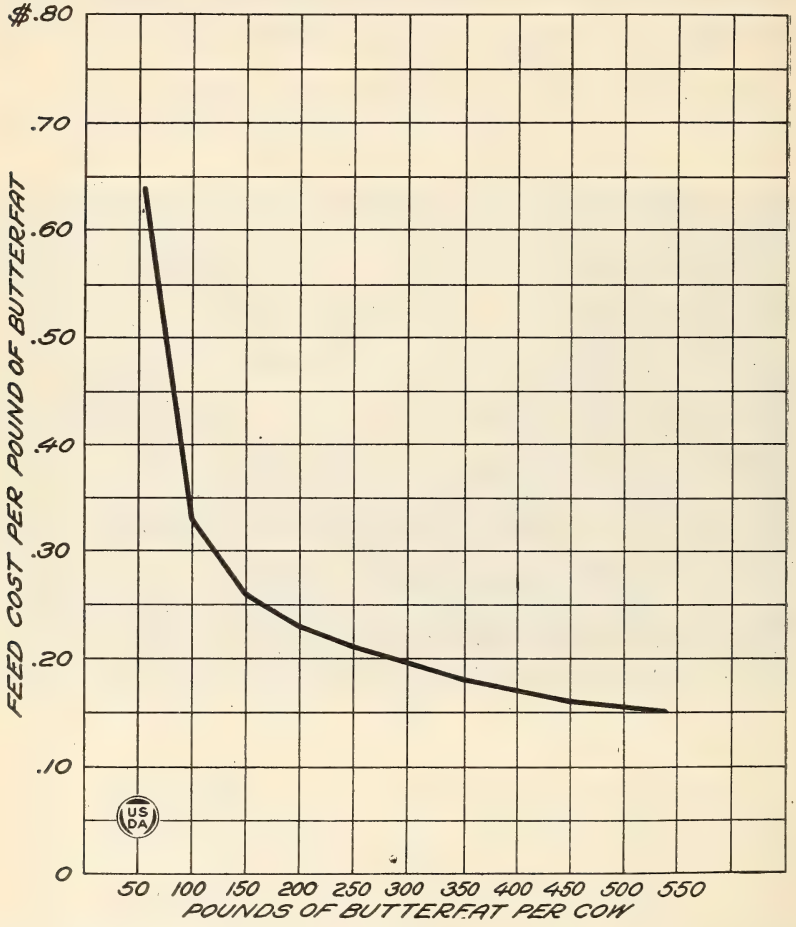

FIG. 7.—Relation between butterfat production per cow and feed cost per pound of butterfat.

product. Within the range of the large groups the high producers always won on income over cost of feed on returns for $1 expended for feed and on low feed cost per pound of butterfat produced.

A STUDY OF HERD RECORDS.

To see whether a study of records by herds would give the same results as a study of individual cow records, a tabulation of the herd

records of many cow-testing associations was made, and is shown in Table 5. For comparative figures from individual cow records see Table 2.

The herd records were sorted according to average production of butterfat per herd, and the income over cost of feed was determined, as usual, by finding the weighted averages of the individual cow

TABLE 5.—*Relation of butterfat production to income over cost of feed as shown by a tabulation of the herd records of 1,309 herds where the product was sold as butterfat; years 1910 to 1920, inclusive.*

Group No.	Number of herds.	Number of cows.	Butterfat production.		Average income over cost of feed.
			Range.	Average.	
			Pounds.	*Pounds.*	
1	2	22	76–125	119	$25.35
2	112	1,556	126–175	161	30.56
3	333	4,496	176–225	205	41.23
4	464	6,724	226–275	251	54.00
5	270	3,443	276–325	297	64.49
6	97	1,171	326–375	344	81.17
7	24	270	376–425	391	93.46
8	5	46	426–475	451	89.42
9	1	6	476–525	496	99.40
10	1	7	526–575	526	45.09
Total	1,309	17,741			
Average				248	52.84

records in each group. As there was no reason to believe that the tabulation of more records would materially affect final conclusions it seemed useless to carry this tabulation farther, though the number of records used in Table 5 was somewhat less than the number used in some of the other tables.

The increase in income over cost of feed as production increased is not quite so marked in Table 5 as in Table 2, because in the former the records were grouped according to herd averages regardless of individual production. Even with that handicap the high-producing herds always showed an increased income over feed cost as production increased from group to group. The average income over cost of feed per cow for the 24 herds in Group 7 was more than three times as great as for the 112 herds in Group 2.

CONCLUSIONS ALWAYS THE SAME.

Tabulations were made, by breeds, of thousands of records of grade and purebred cows to determine the relation of butterfat production to income over cost of feed. In every case the results were very similar to those already given. Tabulations for each age of each breed also gave similar results, and the results were about the same when the records for each association or for any agricultural district were tabulated. *It seems fair, therefore, to conclude that*

increased production is accompanied by increased income over cost of feed regardless of breed, age, weight, date of freshening, or geographical location.

PRICES AND PROFITS.

Several tabulations were made to determine, if possible, whether cows which were large producers of milk and butterfat are relatively more profitable or relatively less profitable when prices are high than when they are low. The results of such tabulations have so far been inconclusive, and for that reason the figures have been omitted. In every case of those studied, however, the low producers had a high feed cost per unit of production, low returns for $1 expended for feed, and small income over cost of feed. In every case the high producers had a low feed cost per unit of production, large returns for $1 expended for feed, and a high income over cost of feed.

RELATION OF MILK PRODUCTION TO INCOME.

MILK PRODUCTION AND INCOME OVER COST OF FEED.

Table 6 shows the relation of milk production to income over cost of feed in associations where the product was sold as whole milk. The results are much the same as those obtained from associations where the income was from the sale of butterfat.

TABLE 6.—*Relation of milk production to income over cost of feed when product was sold as whole milk; years 1915 to 1920, inclusive—From 3,220 yearly records.*

Group No.[1]	Number of records.	Milk production.		Average price of milk per 100 pounds.	Average income over cost of feed.
		Range.	Average.		
		Pounds.	*Pounds.*		
1	16	751- 2,250	1,662	$2.56	$3.47
2	223	2,251- 3,750	3,250	2.53	32.25
3	724	3,751- 5,250	4,605	2.53	59.58
4	927	5,251- 6,750	5,970	2.46	82.96
5	671	6,751- 8,250	7,429	2.40	105.36
6	371	8,251- 9,750	8,918	2.42	131.93
7	181	9,751-11,250	10,354	2.42	156.51
8	58	11,251-12,750	11,881	2.45	181.29
9	34	12,751-14,250	13,250	2.51	218.19
10	7	14,251-15,750	15,042	2.20	224.18
11	4	15,751-17,250	16,076	2.24	219.50
12	1	17,251-17,750	17,387	2.02	223.68
13	1	17,751-18,250	18,207	2.14	212.99
14	1	18,751-19,250	18,894	2.31	286.06
15	1	19,751-20,250	20,168	1.93	222.91
Total	3,220				
Average			6,575	2.45	92.11

[1] The records were sorted on the basis of milk production, allowing a difference of 1,500 pounds between group centers.

As milk production increased from Groups 1 to 9, there was a rapid and very constant increase in income over cost of feed. Beyond Group 9 the number of records in each group was small. In Group 1 the average production of milk was 1,662 pounds and the average income over cost of feed was $3.47. In Group 9 the average milk production was 13,250 pounds and the average income over cost of feed was $218.19. The milk production per cow in Group 9 was about 8 times as much as in Group 1, but the average income over cost of feed in Group 9 was about 62 times as great as in Group 1. This difference was not caused by increased price received for milk, as the average price of milk in Group 9 was lower than in Group 1. The price of milk, however, did not vary greatly within the larger groups.

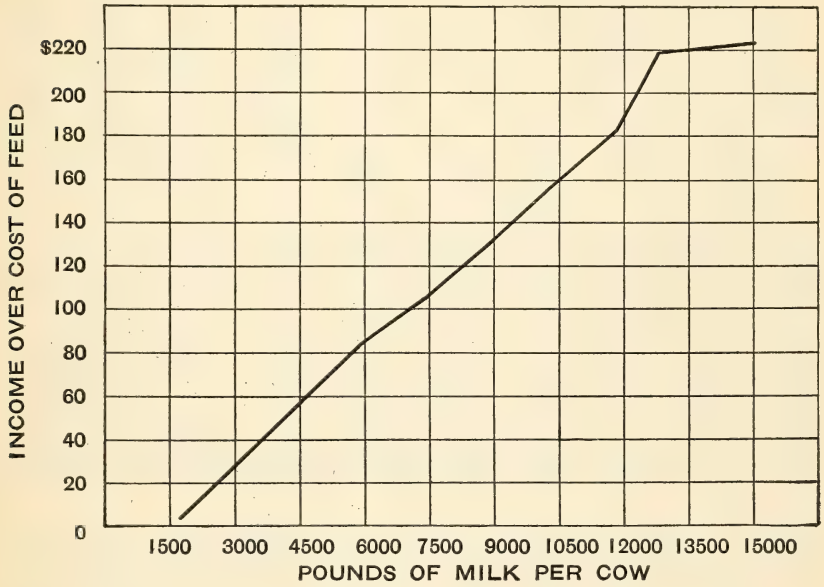

FIG. 8.—Relation between milk production and income over cost of feed.

Figure 8 shows the relation of milk production to income over cost of feed as given in Table 6.

This chart, which includes only the larger groups, is very similar to figure 3, which shows the relation of butterfat production to income over cost of feed. The line is very nearly straight. It shows not merely that large producers have a larger income over cost of feed than small producers, but it measures the increased income over cost of feed in dollars. *A herd of 62 cows like those in Group 1 would be required to produce as much income over cost of feed as was produced by the average cow in Group 9.*

MILK PRODUCTION AND COST OF FEED.

Table 7 shows the relation of milk production to cost of roughage, cost of grain, and total cost of feed. The table is a continuation of Table 6.

TABLE 7.—*Relation of milk production to cost of feed where the product was sold as whole milk.*

Group No.	Number of records.	Average milk production.	Average cost of feed.		
			Roughage.	Grain.	Total.
		Pounds.			
1	16	1,662	$28.74	$10.43	$39.17
2	223	3,250	32.69	17.26	49.95
3	724	4,605	33.15	23.79	56.94
4	927	5,970	35.09	29.09	64.18
5	671	7,429	38.18	34.62	72.80
6	371	8,918	42.36	41.65	84.01
7	181	10,354	45.66	48.38	94.04
8	58	11,881	50.63	59.75	110.38
9	34	13,250	51.39	63.45	114.84
10	7	15,042	49.03	58.59	107.62
11	4	16,076	55.80	84.24	140.04
12	1	17,387	49.20	77.74	126.94
13	1	18,207	57.92	119.24	177.16
14	1	18,894	48.99	100.56	149.55
15	1	20,168	56.40	108.29	164.69
Total	3,220				
Average		6,575	37.06	31.81	68.87

This tabulation is similar to Table 3, in which the income was from the sale of butterfat, but Table 7 shows a more rapid increase in the cost of roughage for each successive group as milk production increased from Groups 1 to 9. The average cost of roughage was more than $1\frac{3}{4}$ times as high for Group 9 as for Group 1, the cost of grain was more than 6 times as high for Group 9 as for Group 1, and the total cost of feed was almost 3 times as high for Group 9 as for Group 1. Beyond Group 9 there were comparatively few records in each group.

TABLE 8.—*Relation of milk production to returns for $1 expended for feed and to feed cost per 100 pounds of milk where product was sold as whole milk.*

Group No.	Number of records.	Average milk production.	Average returns for $1 expended for feed.	Average feed cost per 100 pounds of milk.
		Pounds.		
1	16	1,662	$1.09	$2.36
2	223	3,250	1.64	1.54
3	724	4,605	2.05	1.24
4	927	5,970	2.29	1.07
5	671	7,429	2.45	.98
6	371	8,918	2.57	.94
7	181	10,354	2.66	.91
8	58	11,881	2.64	.93
9	34	13,250	2.90	.87
10	7	15,042	3.08	.72
11	4	16,076	2.57	.87
12	1	17,387	2.76	.73
13	1	18,207	2.20	.97
14	1	18,894	2.91	.79
15	1	20,168	2.35	.82
Total	3,220			
Average		6,575	2.34	1.05

RETURNS FOR $1 EXPENDED FOR FEED.

The figures in Table 8 show the relation between milk production and returns for $1 expended for feed and the relation between milk production and feed cost per 100 pounds of milk. This table is also a continuation of Table 6.

In Group 2 the average milk production was 3,250 pounds, and the average returns for $1 expended for feed $1.64. In Group 9 the average milk production was 13,250 pounds, and the average returns

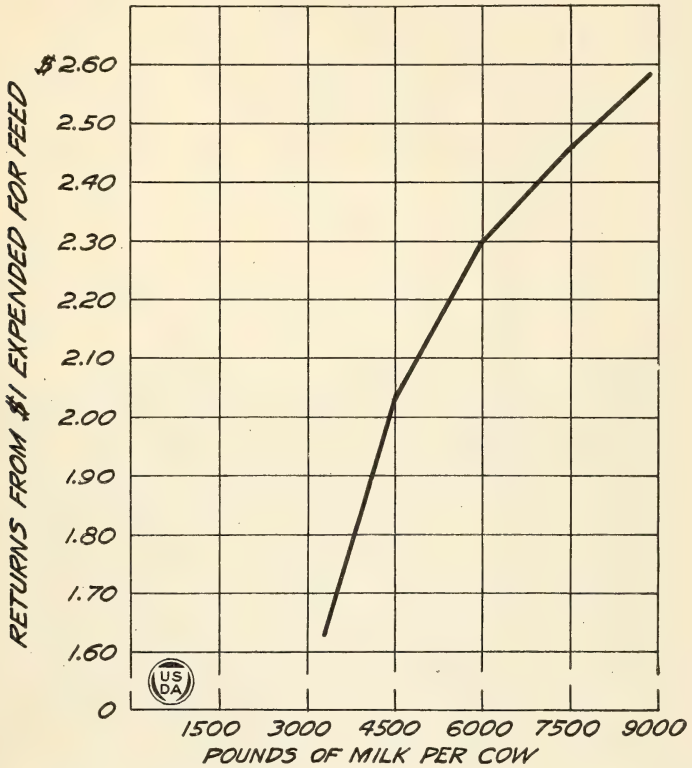

FIG. 9.—Relation between milk production and returns from $1 expended for feed.

for $1 expended for feed $2.90. In Group 2 the average cost of feed for 100 pounds of milk was $1.54, and in Group 9 only $0.87.

Figure 9 shows graphically the relation of milk production to returns for $1 expended for feed.

The figure shows that the returns for $1 expended for feed increased rapidly though somewhat irregularly as milk production increased from Groups 1 to 9. The cows that averaged 12,000 pounds

of milk a year returned about 50 cents more from a dollar's worth of feed than was returned by the cows that averaged 6,000 pounds of milk a year.

Figure 10 shows the relation of milk production to feed cost per 100 pounds of milk.

As milk production increased from Groups 1 to 9 the feed cost per 100 pounds of milk decreased very rapidly at first and more slowly

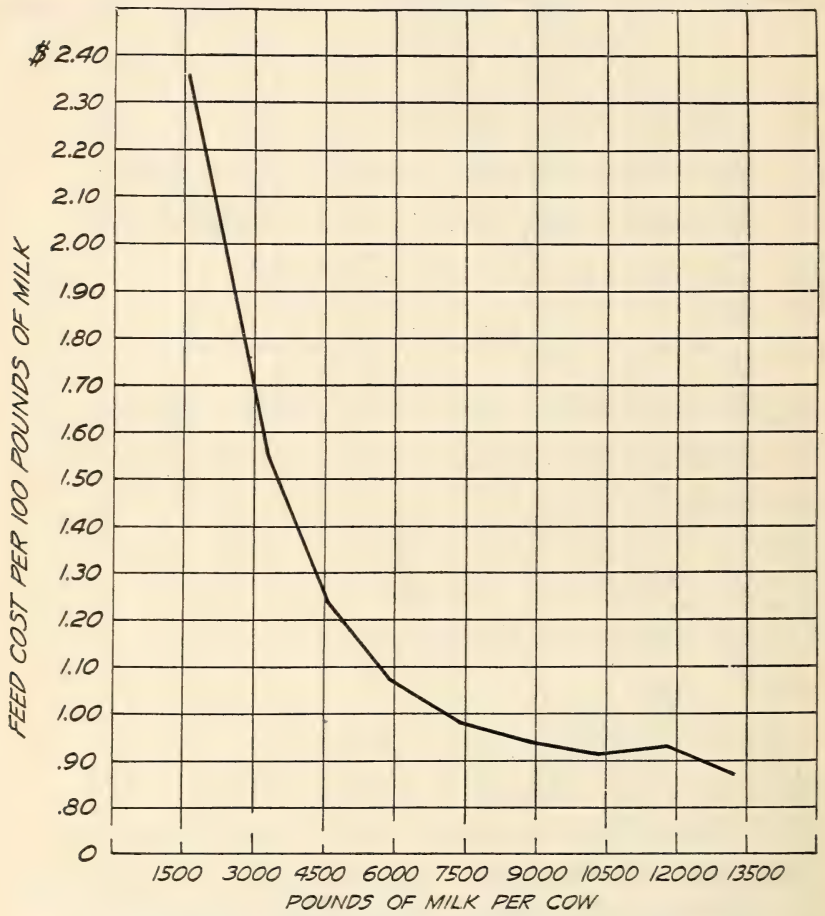

FIG. 10.—Relation of milk production to feed cost per 100 pounds of milk.

as production reached a high level. At current prices for feed the feed cost for each group would vary from the figures given, but recent records show that the direction of the curve would not be greatly changed.

The foregoing evidence, based on cow-testing-association records, shows definitely the greater earning power of high-producing cows

compared with the general average of herds and especially when compared with low producers, and the figures show the degree by which good cows surpass poor ones. Moreover, they throw additional light on the great usefulness and also on some of the limitations of cow-testing associations. The points may be summarized briefly as follows:

WHAT THE COW-TESTING ASSOCIATION CAN AND CAN NOT DO.

The cow-testing-association records take much of the guesswork out of dairying. Conformation indicates performance; but the Babcock test, the milk scales, and the feed scales tell the true story. Knowing the true feed and production records, the good dairyman practices selective breeding, eliminates all low producers that will not respond to better feed and care, and feeds the remainder according to known production.

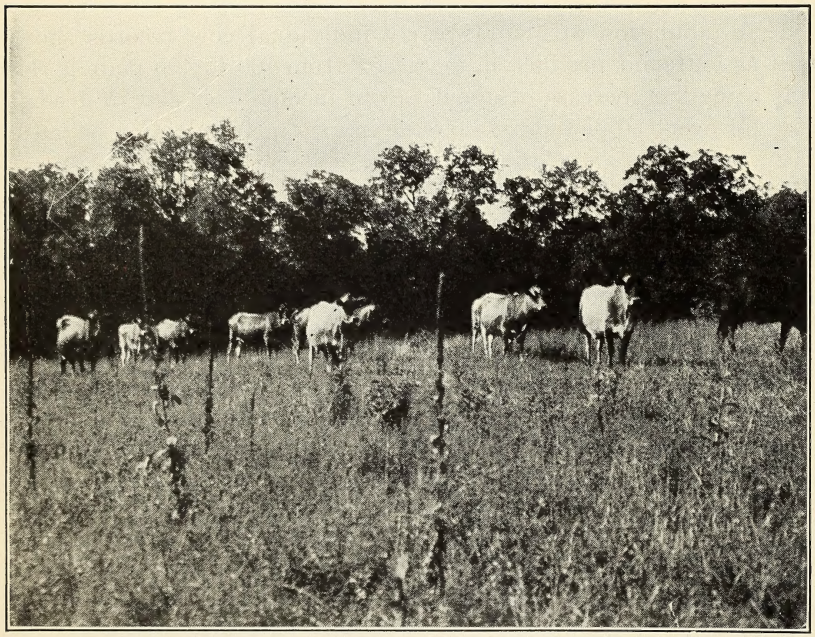

FIG. 11.—The cow-testing-association herd that stood highest in butterfat production in 1918, at Grove City, Pa.

The elimination of low producers is important, but it is not the only work of the cow-testing association. The well-managed cow-testing association saves many cows because it furnishes their actual records of production. It discourages the use of the scoop-shovel method of feeding concentrates, by which all the cows are fed alike, and it encourages the feeding of each cow according to known pro-

duction. Through the weighing and testing of the milk it lets the farmer know which are the high testers and persistent milkers. The careful weighing and testing of the milk has caused many an intelligent dairyman to say: "The cow I thought was the poorest turned out to be one of the best in the herd."

The cow-testing association can accomplish much, but there are a few things it can not do. It can not compel a dairyman to dispose of his poor cows if he is determined to keep them. It can not make him feed according to production nor practice economy in the management of his dairy herd. It can not require him to dispose of his scrub bull and buy a better one. It has never yet demanded the planting of legumes and the building of silos. It can never compel, but it will always encourage and point the way to economical improvement of the herd, of the farm, and of the dairy business.

SUMMARY AND CONCLUSIONS.

1. A tabulation of 18,014 yearly individual cow records showed that as butterfat production increased from 100 to 400 pounds there was a regular increase of about $16 in income over cost of feed per cow for every 50 pounds of increase in average production of butterfat.

2. As production of butterfat increased from 109 to 396 pounds, the returns above the dollar expended for feed increased from 35 cents to $1.52.

3. Tabulations of the records by herds gave results similar to the tabulations of individual cow records.

4. The records show that cow-testing-association cows are seldom fed beyond the point of economical production.

5. The average milk production of 21,234 cow-testing-association cows, each on test 12 months, was 6,077 pounds, and the average butterfat production was 248 pounds. These figures are about 50 per cent above the estimated averages of all the dairy cows in the United States.

6. Cows having high average production of milk and butterfat averaged high in income above feed cost regardless of breed, age, weight, date of freshening, and geographical location.

7. The cows having an average milk production of 3,250 pounds had an average income of $32.25 over cost of feed, while the cows having an average milk production of 13,250 pounds had an average income of $218.19 over cost of feed. The average production per cow in the latter group was about 4 times as great and the average income over cost of feed was nearly 7 times as great as in the other group.

8. This bulletin is based on the tabulation of the figures in 120 sets of records from 96 cow-testing associations.

○